prises an insulative material **72** separating first portion **66** from second portion **68**. Insulative material **72** can comprise, for example, silicon dioxide.

Methods for forming antenna **26***b* will be recognized by persons of ordinary skill in the art. Such methods could include, for example, printing methods similar to those discussed above in discussing FIGS. **1–3** , with the exception that two printing steps would be utilized in forming antenna **26***b*. More specifically, a first printing step would be utilized to form the portion of antenna **26***b* underlying insulative material **72**, and a second printing step would be utilized to form the portion of antenna **26***b* overlying material **72**. Insulative material **72** would be formed between the two printing steps. Insulative material **72** can be formed by conventional methods.

Although the embodiment of FIGS. **10** and **11** is illustrated with only two loops and only one bypass **70**, persons of ordinary skill in the art will recognize that alternate embodiments could be formed comprising more than two loops and a plurality of bypasses **70**. The utilization of one or more bypasses **70** can advantageously permit relatively long loop antennas to be formed on a card substrate.

It is noted that although antenna second portion **68** is illustrated as being substantially perpendicular to antenna first portion **66** at bypass **70**, the invention encompasses other embodiments (not shown) in which an antenna second portion is non-perpendicular to an antenna first portion at a bypass of the antenna portions.

The processing described above with reference to FIGS. **1–11** forms embedded circuits within substrates. Such embedded circuits can comprise, for example, circuitry **22**, **22***a* or **22***b*, and one or more of components **36**, **36***a*, **36***b*, **38**, **38***a* and **38***b*.

Although FIGS. **1–11** illustrate formation of a single card, the invention encompasses methods in which a plurality of cards are formed. Such plurality of cards may be formed by forming a number of recesses within a single sheet, and then dividing the sheet into singulated cards. The division into singulated cards may occur before or after any of the steps illustrated in FIGS. **1–11**. For example, the division into singulated cards may occur after printing of conductive circuitry (shown in FIG. **2**), and prior to provision of components **36** and **38** within a recess. The division of a large sheet into singulated sheets can be performed by a number of methods known to persons of ordinary skill in the art, including, for example, sawing or cutting mechanically or by a laser.

The formation of a number of individual cards from a single sheet substrate is illustrated in FIGS. **12** and **13**. In referring to FIGS. **12** and **13**, similar numbering to that utilized above in describing FIGS. **1–7** is utilized, with differences being indicated by the suffix "c" or with different numerals. Referring to FIG. **12**, a sheet substrate **50** comprises a plurality of recesses **14***c*. Referring to FIG. **13**, the sheet substrate **50** (shown in FIG. **12**) is divided into a number of singular card substrates **10***c* . The individual card substrates **10***c* comprise at least one recess **14***c*. It is noted that the invention encompasses methods in which not all of the individual substrates **10***c* comprise equal numbers of recesses **14***c*, and encompasses embodiments in which some of the individual substrates comprise no recess **14***c*. However, generally at least two of the formed substrates **10***c* will comprise at least one recess **14***c*.

In compliance with the statute, the invention has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the invention is not limited to the specific features shown and described, since the means herein disclosed comprise preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted in accordance with the doctrine of equivalents.

What is claimed is:

1. A method of forming a radio frequency communication device comprising:

providing a recess within a substrate;

providing at least a portion of an antenna within the recess;

providing an integrated circuit at least partially within the recess and in operative electrical connection with the antenna; and

wherein the antenna is a loop antenna which crosses itself at a bypass, said bypass comprising dielectric material between crossing portions of the loop antenna.

2. A method of forming an integrated circuit within a substrate comprising:

if providing a recess in a substrate;

providing substantially an entirety of an antenna within the recess; and

providing an integrated circuit chip and a battery supported by the substrate and in operative electrical connection with the antenna.

3. A method of forming an integrated circuit within a substrate comprising:

providing a recess in a substrate;

providing at least a portion of an antenna within the recess;

providing an integrated circuit chip and a battery supported by the substrate and in operative electrical connection with the antenna; and

wherein the antenna is provided within the recess and on a portion of the substrate outside of the recess.

4. The method of claim **3** wherein the antenna comprises a predominate portion within the recess.

5. The method of claim **3** wherein the antenna comprises a predominate portion outside of the recess.

6. A method of forming an integrated circuit within a substrate comprising:

providing a recess in a substrate;

providing at least a portion of an antenna within the recess;

providing an integrated circuit chip and a battery supported by the substrate and in operative electrical connection with the antenna; and

wherein the antenna is a loop antenna which crosses itself at a bypass, said bypass comprising dielectric material between crossing portions of the loop antenna.

7. The method of claim **3** wherein at least one of the battery and the integrated circuit chip are provided at least partially within the recess.

8. The method of claim **3** wherein the battery is bonded to the substrate within the recess.

9. The method of claim **3** wherein the step of providing the antenna comprises printing a conductive film.

10. The method of claim **3** wherein the step of providing the antenna comprises pad printing a conductive film.

11. A method of forming an integrated circuit within a substrate comprising:

providing a recess in a substrate;

providing at least a portion of a loop antenna within the recess, the loop antenna comprising a bypass where portions of the antenna cross one another, the bypass comprising a dielectric material between the crossing portions of the antenna; and

providing an integrated circuit chip in operative electrical connection with the antenna.

12. The method of claim **11** wherein the portions of the antenna which cross one another are substantially perpendicular to one another.

13. A method of forming an integrated circuit within a substrate comprising:

providing a recess in a substrate;

pad printing a conductive material within the recess to form at least a portion of a conductive circuit within the recess and to form at least a portion of an antenna within the recess;

placing an integrated circuit chip within the recess and bonding the integrated circuit chip to the conductive circuit and the antenna; and

placing a battery within the recess and in electrical connection with the integrated circuit chip.

14. The method of claim **13** wherein the substrate is a card configured for carrying on a person.

15. The method of claim **13** further comprising, after the printing, providing an electroless metal within the recess to selectively plate the conductive circuit.

16. The method of claim **13** further comprising, after bonding the chip to the conductive circuit, filling the recess with a liquid encapsulation material and curing the encapsulation material into a solid mass.

17. The method of claim **13** further comprising, after bonding the chip to the conductive circuit, covering the recess with a protective cover.

18. A method of forming an integrated circuit within a substrate comprising:

providing a substrate having a recess formed therein, said recess having a bottom surface and a sidewall surface joined to the bottom surface;

pad printing a conductive film within the recess to form electrical interconnects within the recess and to form at least a portion of an antenna, the electrical interconnects extending along the bottom surface and the sidewall surface of the recess;

placing an integrated circuit chip within the recess and in electrical connection with the electrical interconnects;

covering the integrated circuit and the conductive film within the recess with a protective cover; and

wherein the integrated circuit comprises radio frequency identification device circuitry, and further comprising placing a battery within the recess and in electrical connection with the radio frequency identification device circuitry through the electrical interconnects.

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